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## **Longfin Inshore Squid**

by

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### **Distribution, Biology, and Management**

Longfin inshore squid (*Loligo pealeii*) are distributed primarily in continental shelf waters located between Newfoundland and the Gulf of Venezuela (Cohen 1976; Roper et al. 1984). In the northwest Atlantic Ocean, longfin squid are most abundant in the waters between Georges Bank and Cape Hatteras where the species is commercially exploited. The stock area extends from the Gulf of Maine to Cape Hatteras (Figure 31.1). Distribution varies seasonally. North of Cape Hatteras, squid migrate offshore during late autumn to overwinter in warmer waters along the shelf edge and slope, and then return inshore during the spring where they remain until late autumn (Jacobson 2005). Bottom trawl survey catches of *L. pealeii* are affected by water temperature, time-of-day, and depth (Serchuk and Rathjen 1974) and the affects vary by body size (Brodziak and Hendrickson 1999; Cadrin and Hatfield 1999). The species lives for about nine months, grows rapidly, and spawns year-round (Brodziak and Macy 1996) with peaks during late spring and autumn. Individuals hatched in summer grow more rapidly than those hatched in winter and males grow faster and attain larger sizes than females (Brodziak and Macy 1996).

The stock is managed by the Mid-Atlantic Fishery Management Council under the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan (FMP). Management measures for the *L. pealeii* stock include annual total allowable catches (TACs) which have been partitioned into seasonal quotas since 2000 (trimesters in 2000 and quarterly thereafter), a moratorium on fishery permits, and a minimum codend mesh size of 1 7/8 inches. The information provided herein reflects the results of the most recent peer-reviewed assessment of the *L. pealeii* stock (NEFSC 2002a; NEFSC 2002b).

### **The Fishery**

The U.S. squid fishery began in the late 1800s as a source of bait, and from 1928 to 1967, annual squid landings from Maine to North Carolina (including northern shortfin squid, *Illex*

*illecebrosus* landings) ranged from 500 to 2,000 mt (Lange and Sissenwine 1980). During 1964-1987, landings of *L. pealeii* by distant water fleets occurred in offshore waters and dominated the total landings during 1967-1984 (Figure 31.2). Total landings increased from 1,700 mt in 1967 to a peak of 37,600 mt in 1973. An inshore domestic trawl fishery developed in 1973, but landings were only several thousand metric tons (Lange and Sissenwine 1980). After 1973, total landings declined to 10,600 mt in 1978 and then increased to 23,700 mt in 1980. During 1982-1989, U.S. fishery landings increased rapidly as offshore domestic fleets developed and quota allocations for distant water fleets were phased out. Since 1987, landings have been solely from the domestic fisheries and have fluctuated between a low of 10,400 mt in 1987 and a high of 23,700 mt in 1989 (Table 31.1). After 1994, landings occurred at lower levels and totaled 17,000 mt in 2005. Since 2000, landings have been affected by seasonal fishery closures which have occurred at least on an annual basis.

The domestic fishery occurs primarily in Southern New England and Mid-Atlantic waters, but some fishing also occurs along the edge of Georges Bank. Fishing patterns reflect seasonal *Loligo* distribution patterns and effort is generally directed offshore during October through April and inshore during May through September. The fishery is dominated by small-mesh otter trawlers, but near-shore pound net and fish trap fisheries occur during spring and summer. Since 1984, annual offshore landings have generally been three-fold greater than inshore landings.

Discarding of *Loligo* occurs primarily in small mesh trawl fisheries. Regulatory discarding of *Loligo* occurred during 2000-2003 when seasonal *Loligo* quotas were frequently attained (MAFMC 2006).

### **Research Vessel Survey Indices**

The distributional range of longfin squid extends beyond the area sampled by NEFSC bottom trawl surveys, but the greatest degree of overlap occurs during autumn surveys. Autumn survey indices (Figure 31.3) are adjusted for diel differences in catchability by size (Brodziak and Hendrickson 1999; NEFSC 2002a) and do not include inshore (< 27 m) *Loligo* habitat (Jacobson 2005). Annual autumn relative abundance indices are highly variable, in part, because relative abundance is affected by oceanographic conditions (Dawe et al., *In Press*). During 1967-2005, autumn survey indices varied with little trend, except that relative abundance was consistently below the time series average during 1967-1972 and above the time series average during 1999-2002 (Figure 31.3). After 2002, relative abundance declined and was below average in 2005.

### **Assessment Results**

The *L. pealeii* stock was last assessed in November 2001 (NEFSC 2002a). Surplus production model results indicated that quarterly biomass ranged between 14,000 mt and 27,000 mt and averaged 21,800 mt during 1987-2000. Quarterly fishing mortality rates ranged between 0.06 and 0.6 and averaged 0.24. During 2000, average biomass was 24,000 mt and the fishing mortality rate was 0.20.

### **Biological Reference Points**

Biological reference points were specified in 1998 (MAFMC 1998) based on recommendations from the Overfishing Definition Review Panel (Applegate et al. 1998) (Table 31.2). The fishing mortality rate threshold is defined as an  $F_{MSY}$  proxy equal to  $F_{max}$ , estimated as 0.36 per month (NEFSC 1996), when the annual stock biomass is greater than the  $B_{MSY}$  proxy of 80,000 mt (Applegate et al. 1998), then decreases linearly to zero at a biomass of 30,000 mt. The target fishing mortality rate is defined as 75% of  $F_{max}$  when stock biomass is greater than  $B_{MSY}$ , then decreases linearly to zero at the biomass threshold of 40,000 mt (50% of  $B_{MSY}$ ).

During the 2001 assessment, a quarterly per-recruit model was also run but  $B_{MSY}$  could not be estimated and neither the new F-based reference point estimates nor the existing  $B_{MSY}$  reference point were considered appropriate for stock status determination. Rather, a new  $F_{threshold}$  proxy of 0.31 per quarter, representing the 75<sup>th</sup> percentile of the fishing mortality rates during 1987-2000, was used to evaluate stock status with respect to overfishing. During 2000, overfishing was not occurring because  $F_{2000}$  was below the proposed  $F_{threshold}$  of 0.31 and stock status with respect to biomass was unknown because there were no appropriate biomass-based reference points available with which to compare the 2000 biomass estimate (NEFSC 2002b).

## Summary

The stock status determination for 2000 is outdated because *Loligo* is a sub-annual species. During 1999-2002, autumn relative abundance indices were well above the time series average and among the highest levels on record. Thereafter, relative abundance declined and was below average in 2005. Landings generally declined after 1999, and in 2003, reached the lowest level since 1987. The decline is partially due to frequent seasonal closures of the directed fishery, which has also resulted in regulatory discarding of *Loligo*. After 2003, landings increased and were slightly below the 1987-2004 average in 2005.

**Table 31.1** Recreational and commercial landings of *Loligo pealeii* (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States <sup>1</sup>	18.4	12.0	16.3	18.2	19.4	17.5	14.3	16.8	11.9	15.4	17.0
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total Nominal Catch</b>	<b>18.9</b>	<b>12.0</b>	<b>16.3</b>	<b>18.2</b>	<b>19.4</b>	<b>17.5</b>	<b>14.3</b>	<b>16.8</b>	<b>11.9</b>	<b>15.4</b>	<b>17.0</b>

<sup>1</sup> Includes prorated landings of squid (e.g., *Illex illecebrosus* or *Loligo pealeii*) not reported by species.

**Table 31.2** MSY-based reference point proxies for the *Loligo pealeii* stock.

### MSY-based Reference Points

$B_{MSY}$  proxy<sup>1</sup> = 80,000 mt per year

$F_{MSY}$  proxy<sup>2</sup> = 0.36 per month

<sup>1</sup>Derived from NEFSC survey swept-area indices for spring and autumn combined

<sup>2</sup>Based on a nine month lifespan

## For further information

- Applegate, A., S. Cadrin, J. Hoenig, C. Moore, S. Murawski, and E. Pikitch. 1998. Evaluation of existing overfishing definitions and recommendations for new overfishing definitions to comply with the Sustainable Fisheries Act. Final Report, Overfishing Definition Review Panel. New England Fishery management Council, Newburyport, Massachusetts. 179 pp.
- Brodziak, J.K.T. and L.C. Hendrickson. 1999. An analysis of environmental effects on survey catches of squids *Loligo pealei* and *Illex illecebrosus* in the northwest Atlantic. Fish. Bull. 97: 9-24.
- Brodziak, J. K. T., and W. K. Macy, III. 1996. Growth of long-finned squid, *Loligo pealeii*, in the northwest Atlantic. Fish. Bull., 94: 212-236.
- Cadrin, S. X. and E. M. C. Hatfield. 1999. Stock assessment of longfin inshore squid, *Loligo pealeii*. Northeast Fish. Sci. Cent. Ref. Doc. 99-12, 107 p.
- Cohen, A. C. 1976. The systematics and distribution of *Loligo* (Cephalopoda, Myopsida) in the western North Atlantic, with descriptions of two new species. Malacol.15(2): 299-367.
- Dawe, E. G., L. C. Hendrickson, E. B. Colburne, K. F. Drinkwater, and M. A. Showell. *In Press*. Ocean Climate effects on the relative abundance of short-finned (*Illex illecebrosus*) and long-finned (*Loligo pealeii*) squid in the Northwest Atlantic Ocean. Fish. Oceanog.
- Jacobson, L. 2005. Essential fish habitat source document: longfin inshore squid, *Loligo pealeii*, life history and habitat characteristics, Second Edition. NOAA Tech. Memo. NMFS-NE-193, 42 p.
- Lange, A.M.T., and M.P. Sissenwine. 1980. Biological considerations relevant to the management of squid *Loligo pealei* and *Illex illecebrosus* of the Northwest Atlantic. Mar. Fish. Rev. 42(7-8):23-38.
- Mid-Atlantic Fishery Management Council (MAFMC). 1998. Amendment 8 to the Atlantic mackerel, squid, and butterfish management plan. Dover, DE. 351 p. plus appendices.
- Mid-Atlantic Fishery Management Council (MAFMC). 2006. Amendment 9 (Draft) to the Atlantic mackerel, squid, and butterfish management plan. Dover, DE. 341 p. plus appendices.
- Northeast Fisheries Science Center (NEFSC). 1996. Report of the 21<sup>st</sup> Northeast Regional Stock Assessment Workshop (21<sup>st</sup> SAW): Public Review Workshop. Northeast Fish. Sci. Cent. Ref. Doc. 96-05h, 72 p.

- Northeast Fisheries Science Center (NEFSC). 2002a. Report of the 34th Northeast Regional Stock Assessment Workshop (34<sup>th</sup> SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fish. Sci. Cent. Ref. Doc. 02-06, 346 p.
- Northeast Fisheries Science Center (NEFSC). 2002b. Report of the 34th Northeast Regional Stock Assessment Workshop (34<sup>th</sup> SAW): Public Review Workshop. Northeast Fish. Sci. Cent. Ref. Doc. 02-07, 32 p.
- Roper, C. L., M. J. Sweeney, and C. E. Nauen. 1984. FAO species catalogue. Vol. 3 Cephalopods of the World: an annotated and illustrated catalogue of species of interest to fisheries. FAO Fish. Synop. No. 125, Vol. 3, 277 p.
- Serchuk, F.M. and W.F. Rathjen. 1974. Aspects of the distribution and abundance of the long-finned squid, *Loligo pealei*, between Cape Hatteras and Georges Bank. Mar. Fish. Rev., 36: 10-17.

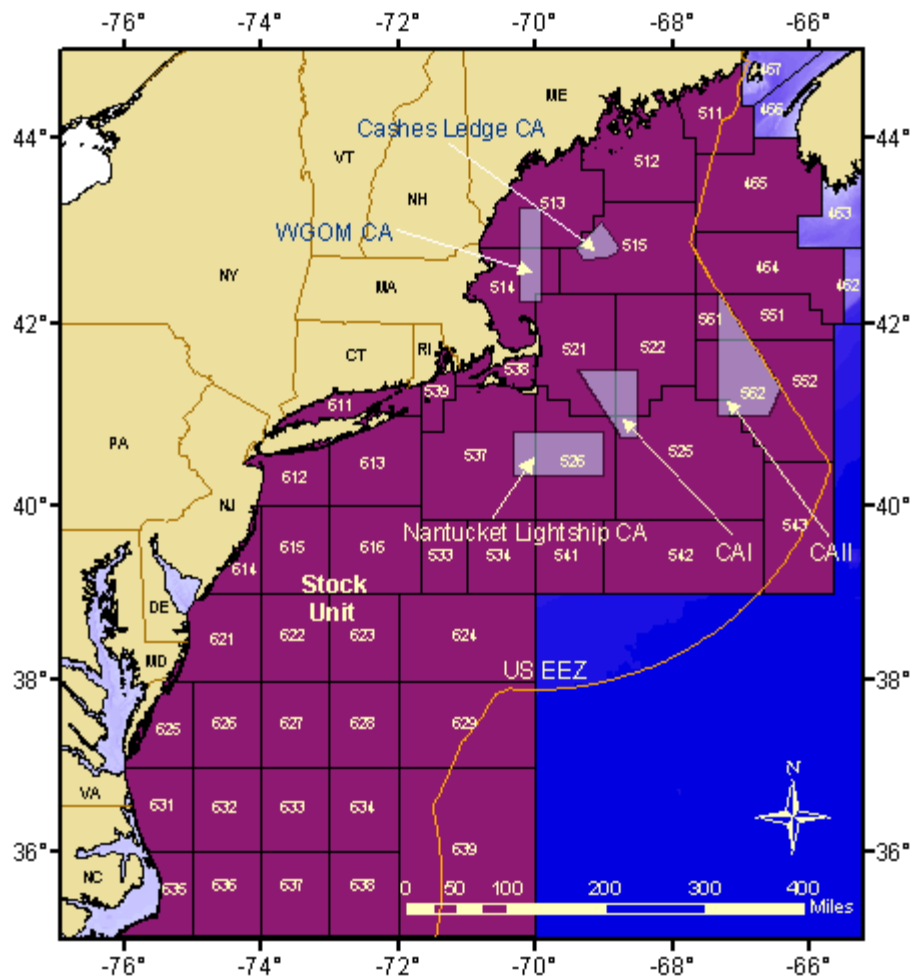


Figure 31.1. Statistical areas used to define the *Lolligo* squid stock.

*Loligo pealeii*  
Commercial Landings

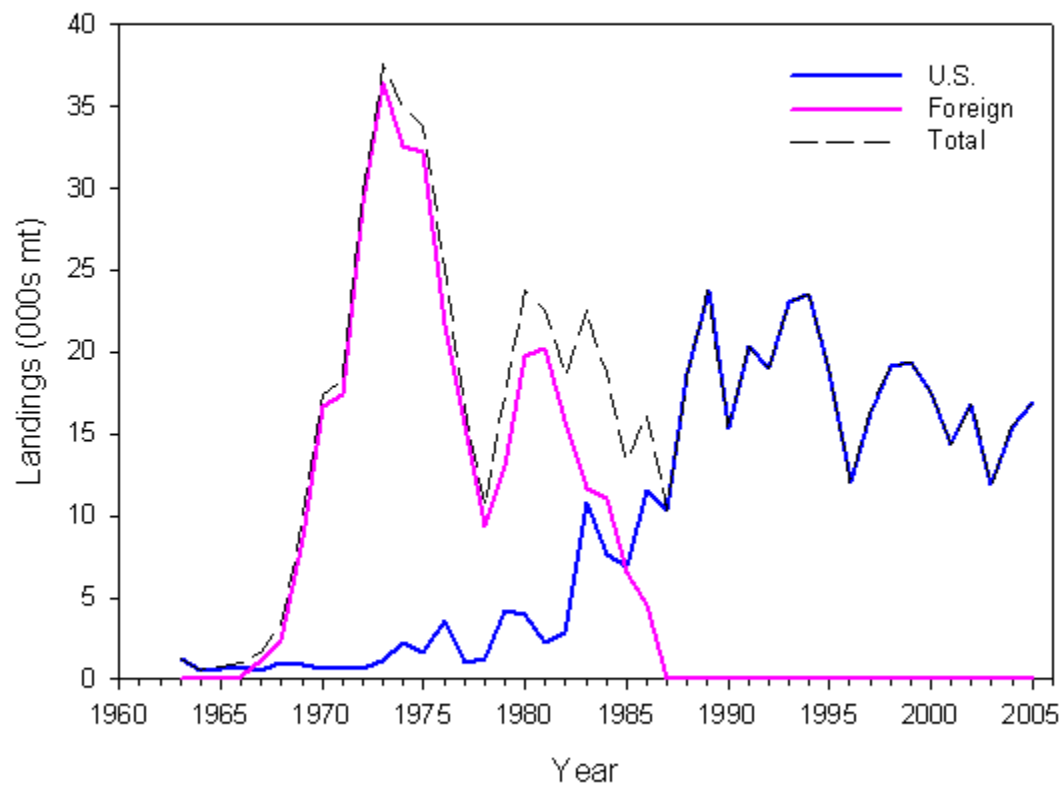
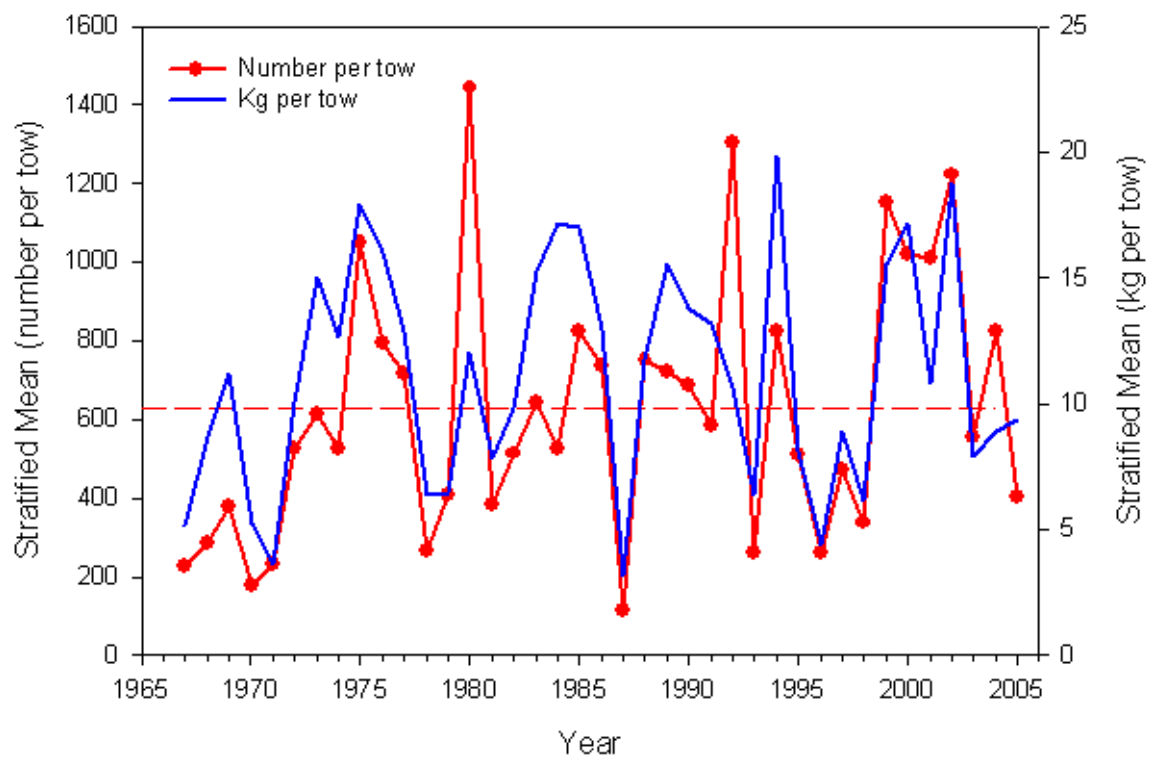


Figure 31.2. Commercial landings of *Loligo pealeii*.

# *Loligo pealeii* Autumn Survey Indices



**Figure 31.3.** Indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) for *Loligo pealeii* based on NEFSC autumn bottom trawl surveys. The dashed red line represents the 1967-2004 average stratified mean number per tow.